11. Agricultural Mechanization and Energy Management

Straw reaper with integrated straw container: A tractor-drawn straw reaper with trailer was re-designed with the straw collection container mounted over the reaper itself to improve field maneuverability and to simplify loading and unloading. The weight of the unit was brought down from 3,200 kg to only 2,200 kg, saving material and cost of production of the same. As compared to the existing straw reaper trailer system, the unit has less turning radius, convenient loading and unloading of straw, reduced fuel consumption with straw output of 703 kg/hr. The straw reaping cost was reduced by 30% as compared to the conventional straw reaper-trailer system.

Modified straw reaper

Narrow wheel tractor and equipment for cultivation of soybean-wheat and pea-Frenchbean crops on raised and flat bed: Narrow width tyres (8.3 × 32 – 8 PR) were fitted to a standard 35 hp tractor having provision for adjusting ground clearance from 300 to 500 mm and front power take off (pto) drive for the cultivation of soybean-wheat and pea-Frenchbean on raised and flat beds. The narrow wheel prime mover was extensively evaluated with matching implements for various operations such as tillage, sowing/planting, interculture, chemical spraying and harvesting. The tractor-machine system was evaluated in the field at different forward speeds of operations and was found to have field capacity ranging from 0.2 to 1.7 ha/hr with wheel slip ranging from 8 to 11%.

Self-propelled intra-canopy pesticide application system: A sleeve boom intra-canopy spraying system was developed for enhanced efficiency of spray depositing on target plants. The spraying system consists of 30 hollow cone nozzles and has six vertical sleeve booms with five nozzles for each row for effective coverage of the entire foliage of the plant in the row. Air to the sprayer is provided with a centrifugal blower having air discharge capacity of 2 m^3/s. The velocity and pressure of air can be adjusted to the required levels. Width of coverage of the sprayer can be adjusted from 3.6 to 7.2 m as per the requirements of different crops.

Fodder harvester: The fodder harvester has an offset reciprocating cutter bar which can be hydraulically controlled for height of cut depending upon the stage and type of fodder being harvested. It is suitable for green forage corps including berseem, oats, sorghum, maize, guinea and natural grasses. The speed of operation for cutting soft natural grasses is 0.9 to 1.0 m/s, whereas in the case of fodders like berseem, lucerne etc. it can be operated at speeds of up to 2.0 m/s. Effective width of cut was 1.8±0.1 m, giving field capacity of 0.40 to 0.44 ha/hr with field efficiency of 67–80% and cutting efficiency of 96%. Minimum height of cut achieved by this machine was 10±2 cm. Six man-days and one tractor operator were required to harvest fodder from one ha of land, to gather and to bring it to the transportation lane of tractor trolley as against minimum of 33 man-days to harvest, collect and gather crop in the conventional method.

High capacity chaff cutter: This high capacity mobile chaff cutter-cum-blower loader was found suitable for chaffing fodder crops and residues ranging from soft stemmed crops such as berseem, guinea, napier, cenchrus to stiffer stemmed crops such as maize, sorghum and oats. Operated with the pto of a standard tractor, it is a compact unit having feeding chute, chaffing mechanism and blower unit to move chaffed material. The inflow of air in blowing spiral is controlled through an adjustable opening in the duct and the quantity of inflow air can be increased or decreased. More air is allowed to pass through the duct when moisture content of the crop is more than 50% as in case of freshly harvested green fodder. Chaffing efficiency of the cutter varied from 92 to 100% depending upon the moisture content and stiffness of the crop.

Animal-drawn engine-operated sprayer: An animal-drawn engine-operated sprayer suitable for pigeonpea and cotton was developed which was an improvement over the traditionally used two-spray gun sprayer, popular in Maharashtra. This unit has a field capacity of 1.19 ha/hr as compared to 0.66 ha/hr in the conventional system. Due to higher field capacity, there is saving in the time and cost of operation to the tune of 50%, besides achieving more economy in application of plant protection chemicals.

Rear overturning protection mechanism for tractor trailer: A safety gadget was developed for preventing accidents due to overturning of two-wheel tractor trailers. It consists of a hydraulic top link which is fitted between the tractor and the trailer. The hydraulic

top link develops a resistive force which prevents tractor trailer system from overturning. With a trailer load of 3 tonnes, the front tractor wheels are allowed to lift up to an angle of 5º only. Further overturning is arrested by the hydraulic top link mechanism.

Safe feeding conveyor system for multicrop threshers with rasp bar type cylinders: An automatic chain type feed conveyor was developed for commercial multicrop threshers for enhanced comfort and safety of the users. The feed chute is located at 1,100 mm from the ground level for easy and comfortable feeding, based on the anthropometric considerations. The outer end of the feeding chute is provided with an inclination of 25º with respect to the horizontal for easy handling of the harvested produce. This improved feeding system resulted in 28% and 35% saving in cost and time, respectively as compared to the manual feeding by the conventional method.

Ergonomically refined climbing device for coconut trees: For enhanced comfort, safety and ease of working, the coconut tree-climbing device was ergonomically evaluated and adapted. It consists of two parts, an upper frame and a lower frame which are alternatively raised by the user to attain desired elevation on the coconut tree. The worker can move around the trunk of the tree for harvesting and crown-cleaning of tall coconut palms. High work stress, discomfort in neck, back, legs and hands caused in traditional method of harvesting could be reduced to bare minimum with this device. The output using the coconut tree-climbing device was 50–60 nuts/hr as compared to 25–30 nuts/hr in the conventional method.

Arecanut tree climber with harvesting tool: The climbing device consists of an upper frame and a lower frame which are alternatively raised by the user to attain desired elevation on the arecanut tree. The device has a gripping aid which could be adjusted to the girth of the arecanut tree. The harvesting tool enables the user to position cutting edge on the peduncle of the bunch and complete harvesting by slicing and impacting.

Arecanut stripper: The hold-on type arecanut stripper consists of a feed chute, peg tooth cylinder, stripping mechanism and an oscillating sieve placed below the cylinder. The nuts get separated from the bunch due to the impact action of the pegs provided on the rotating cylinder, and the stripped nuts fall on the oscillating sieve. Protective guards are provided for all the moving parts. It is suitable for stripping both green and ripe arecanut bunches. It has a capacity of 650–950 kg of nuts/hr with striping efficiency of 99.5%.

Hold-on type arecanut stripper

Women-friendly arecanut dehusker: A women-friendly hand-operated arecanut dehusker was developed for removing husk and separating nuts which are suitable for drying and marketing. It consists of a rasp type blade, slot for placing arecanut, a handle with grip, a spring loaded holding device with a handle, all mounted on a suitable frame and placed on a table of convenient height. The device can handle dry as well as green arecanuts. One woman worker can achieve an output of 9.5 kg/hr for the green arecanuts and 2.9 kg/hr for the dry ones.

Women-friendly tea plucker: A scissor-type tea plucker was developed for ensuring better health and safety with improved work efficiency and reduced drudgery of women workers in the tea plantations. The unit consists of a light weight collection tray, nylon net lid, a pair of mild steel blades and nylon handle grip for operating the plucker weighing only 800 g. The output of a woman worker using this unit was 8.6 kg/hr of green tea leaves which is about 40% higher as compared with conventional method of hand plucking.

Mechanized bud chipping: A power-operated, pneumatically controlled bud chipping machine was developed for chipping sugarcane buds. It has a capacity of 1,200 buds/hr as compared to 550 buds/hr of the pedal-operated unit and 125–150 buds/hr by the conventional method of manual chipping. The machine costs ₹ 12,000 excluding an air compressor which is required for its operation.

Potting machine for spices nursery: A potting machine for spices nursery was developed for mixing, pulverizing and vending potting mixture in poly-bags of 250, 500 and 1,000 g capacity. It is operated by a 2.2 kW motor and has a capacity of handling 100 kg/hr of potting mixture.

Guggul tapping tool: A simple hand tool was developed for tapping guggul from its tree trunk. The stainless steel tool has a circular sharp-edged blade of 40 mm diameter and 2 mm thickness, which is mounted on a handle designed for convenient and firm grip for its operation. It can make incision (blaze) of 2 mm depth of desired length without damaging hard wood. The tool, weighing 150 g and costing ₹ 125, is capable of blazing 10 guggul plants (5 blazes/plant) in one hour.

Low density polyethylene-lined ponds in Uttarakhand: Low density polyethylene-lined small ponds were found quite effective in providing supplemental irrigation to horticultural/vegetable production in hilly areas. Water resources of 2,417 m^3 capacity were developed in the farmers' fields in village Bhagartola in Almora and village Darim in Naini Tal.

LDPE film-lined ponds constructed in Uttarakhand

The capacity of the tanks ranged from 10 to 289 m^3. The source of water for these tanks was runoff and low discharge natural springs. The supplemental irrigation from such developed tanks helped in 14.7% to 27.8% increase in the productivity of different vegetables.

Self-propelled rice transplanter: Eight-row power-operated rice transplanter with the covering capacity of 0.2 ha/hr resulted in saving of 82 labourers/ha and economic savings of 50%.

Implements developed for horticultural crops: A tractor-operated hydraulic harvesting platform for fruit trees was designed and developed. The hand-operated pomegranate aril remover developed earlier was modified as motorized aril remover. A new light weight harvester for arecanut and cocoa and 200 nut capacity shell fired copra dryer were developed. A coconut chips slicing machine was developed to produce coconut chips of required uniform thickness. A conceptual design of motorized concentric type rotary sieve grader was developed for cashew.

In potato, prototype for mini-tuber production through aeroponic technology was designed, developed and tested. This system consists of a growth chamber, nozzles, nutrient solution tank, high pressure pump, filter, electrical and electronic components and other accessories. The efficacy of the system is found 3 to 4 times higher than the conventional tissue culture technique. Besides, there is no risk of soil and tuber-borne diseases as the micro-tubers are grown in soil-less medium. A high capacity treatment, special pallets were designed and fabricated. The system has since been put to use.

The high capacity mechanized (use of fork lift) seed potato treatment system was designed, developed and tested to reduce human drudgery and improve working efficiency. A six-row tractor-operated onion transplanter for flat bed was also designed and fabricated.

Jute nail weeder

Nail weeder (with 5–6 nails) was found to control 80% of weeds after 4 to 30 days of their emergence. Net benefit of this system ranges from ₹ 3,000 to 5,000/ha over the manual weeding twice (Patent application No. 386/Kol/2010).

Designing of low-cost grit filter for carp rearing in mid hills: A low-cost grit filter that can be used for water purification and considerable reduction of nutrient load in the fish pond in hilly regions was designed. The filter helps combat frequent incidences of algal production in the ponds during April–June when there is scarcity of water in hills resulting in mortality of fish due to sudden depletion of dissolved oxygen during the night time. This filter was found efficient to remove 70% physical impurities (clay + algal cells) with 1–1.5 ppm improvement in dissolved oxygen. The inlet flow rate was 32 litre/m. After inoculation of nitrifying bacteria, this small filter was found efficient to reduce ammonium level from 0.6 to 0.3 ppm and nitrite level from 0.046 to 0.017 ppm.

Herbicide brush

Non-selective herbicides application in between crop rows by using the brush reduced composite weed flora and saved ₹ 4,000–5,000/ha as compared to manual weeding twice. It controlled 80% of weeds in between the rows. Only one hand weeding was required to control remaining 20% weed in between the rows. (Patent application No.319/KOL/2010).

Fish drying in polyhouse dryer in Saurashtra region: Solar tunnel dryer of the single span arc polyhouse type was developed and tested. Its dimensions are 21.3 m height, 4.6 m width and 2.2 m height. Five passive turbine vents were provided at the top, along the length of the tunnel dryer to enhance air movement and scavenging moisture laden air. At no load conditions, inside temperature was 5 to 15°C higher than the ambient temperature for different vent openings. However, temperature remained below 50°C with any single side full vent opening.

Croaker, Anchovy and Ribbon fish varieties were tested for drying with and without salt treatment by loading the fish on the wire net or jute net inside the dryer. Effect of moisture content on drying rate of each variety of fish in salted and unsalted conditions in the temperature range of 40–45°C and 45–49°C showed that drying rate remained higher in solar tunnel drying as compared to open sun drying for both the treatments.

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